REMARKS/ARGUMENTS

Claims 1-10 are pending in the application. By this Amendment, claim 9 is being amended to improve its form. No new matter is involved.

Beginning on page 3 of the Office Action, the claims are rejected on various combinations of references, including U.S. Patent 5,968,264 of Iida, U.S. Patent 6,277,501 of Fujikawa, U.S. Patent 6,162,708 of Tamatsuka et al., U.S. Patent 5,954,873 of Hourai et al. and U.S. Patent 6,641,888 of Asayama et al. These rejections, which are respectfully traversed, are addressed below in the order in which they appear in the Office Action.

In Paragraph 3 which begins on page 3 of the Office Action, claims 1 and 5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Iida et al. in view of Fujikawa. According to such rejection, Iida discloses a method of forming a silicon wafer with an N-region formed over the entire surface, and although Iida does not disclose that the silicon single crystal is pulled while doping with carbon, Fujikawa teaches growing a silicon single crystal while controlling the carbon concentration and the oxygen concentration. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Iida with Fujikawa to promote precipitation of oxygen, thereby producing an epi-water without an expensive EG treatment. This is the same reason for the rejection previously made.

Furthermore, and on page 4 of the Office Action, it is asserted that the combination of Iida and Fujikawa is silent to the silicon single crystal being pulled at a rate greater than the rate of pulling a silicon single crystal with no carbon doping. Iida is said to teach, through the adequate adjustment of the pulling rate, that the N-region can be formed over the entire crystal cross section. Therefore, according to the Office Action, it would have been obvious to a person of ordinary

skill in the art at the time of the invention to modify the combination of Iida and Fujikawa by optimizing the pulling rate to obtain a pulling rate greater than the rate of pulling a silicon single crystal with no carbon doping conducting routine experimentation of a result effective variable. This is the reasoning given in response to Applicants' previous amendment.

However, because the reason for rejecting claims 1 and 5 as unpatentable over Iida in view of Fujikawa is the same as that previously made, Applicants' argument is also the same as that set forth in the previous responses. Moreover, it is apparent that Applicants' arguments are still not understood.

Certainly, Iida discloses a method of forming a silicon wafer with an N-region formed over the entire surface, and Fujikawa teaches growing a silicon single crystal while controlling the carbon concentration and the oxygen concentration. However, there is no motivation to combine Iida with Fujikawa. Iida has no description or suggestion, not only of doping with carbon but also promoting precipitation of oxygen. On the other hand, Fujikawa does not describe or suggest growing a silicon single crystal with an N-region.

Consequently, there is no basis for combining such references to promote oxygen precipitation. It is clear that the present invention is arrived at by the attempted combination of Iida and Fujikawa only with the benefit of hindsight.

Inherently, in claim 1 of the present Application, pulling the silicon single crystal with an N-region while doping with carbon is based on the discovery that "by doping with carbon, the single crystal having the N-region can be pulled faster than the single crystal in the case of not doping with carbon, an improvement of productivity of the silicon single crystal having no grow-in defect and decrease in cost can be achieved", which is discovered by the present inventors for the first time, as described at lines 16-21 of page 8 and at lines 2-17 of page 15 of the specification.

Therefore, as long as it is unknown that a pulling rate possible to obtain the N-region shifts faster by doping with carbon, the idea of doping with N-region crystal with carbon as described in the present application cannot be derived.

On the other hand, the references cited in the Office Action do not show or suggest this at all. Moreover, by doping with carbon in the entire N-region, as described at lines 3-14 of page 16 of the specification, formation of oxygen precipitation nuclei at low temperatures (600-1000°C) is accelerated in the case of doping with carbon. A wafer with carbon doping is subjected to such a low temperature heat treatment that the difference of precipitation between the N (V) region and the N (I) region can be practically eliminated. This indicates that there can be obtained the effect that the entire N-region wafer with carbon doping has a high level of stable IG ability in the entire wafer plane.

Accordingly, a person of ordinary skill in the art cannot derive the present invention from Iida in combination with Fujikawa. Therefore, claim 1 should be allowed, and the same is true of claim 9 as amended herein. Moreover, because claim 5 is dependent on claim 1, claim 5 should also be allowable for the same reasons set forth above.

On page 4 thereof, the Office Action asserts that Iida teaches through the adequate adjustment of the pulling rate that the N-region can be formed over the entire crystal cross section. Therefore, according to the Office Action, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Iida and Fujikawa by optimizing the pulling rate to obtain a pulling rate greater than the rate of pulling a silicon single crystal with no carbon doping. It is apparent that the present invention is not correctly understood.

Even when the pulling rate is adequately adjusted in the case of Iida, it is impossible to pull a silicon single crystal at a rate greater than the rate of pulling a

single crystal with no carbon doping as in the case of the present invention. The finding of the present invention that a pulling rate possible to obtain the N-region can be increased by doping with carbon means that the V/G value possible to obtain the N-region shifts by doping with carbon. Because the temperature gradient G is not changed by doping with carbon, that is the pulling rate possible to obtain the N-region shifts faster irrespective of not changing the value G, the V/G value to be controlled is changed.

Thus, as described on page 15 of the present application, in the case of not doping with carbon, the pulling rate possible to obtain the N-region is 0.52-0.54 mm/min. Therefore, in the method of Iida, the pulling rate is adequately adjusted so as to have a pulling rate within the above range, and the crystal having the N-region is pulled while setting a V/G value as a predetermined value. The pulling rate is adequately adjusted so as to obtain the V/G value.

However, and in accordance with the discovery of the present invention, the pulling rate possible to obtain the N-region shifts to 0.63-0.65 mm/min by doping with carbon. Therefore, the V/G value to be controlled is also changed (to 0.183-0.177 $mm^2/K.min$ in this case). Because it is unknown in Iida, Hourai or the other cited references that a V/G value shifts by carbon doping, it is impossible for the cited references to control the pulling rate to the above range. Because the dependence of dopants on the V/G value is unknown in the case of the cited references, the V/G is controlled in such references at the same value as in the case of not doping with carbon. Therefore, it is clearly impossible to control a pulling rate or a V/G value to a value shifting faster, as in the case of the present invention. It is impossible to adequately adjust the value to an unknown value. As described above, the assertion in the Office Action is based on a misunderstanding, and the present invention is not suggested by the cited references.

Moreover, the Office Action also asserts that it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Iida and Fujikawa by optimizing the pulling rate to obtain a pulling rate greater than the rate of pulling a silicon single crystal with no carbon doping. However, inherently, the Office Action derives the present invention by combining Iida and Fujikawa and modifying the combination in accordance with the teaching provided by the present invention. It is not admitted, of course, that the present invention is derived from such a two-step logical leap, but if the present invention can be derived only from such a two-step logical leap, this clearly affirms the patentability of the present invention.

As described above, it is clear that claim 1 and its dependent claims clearly distinguish patentably over the prior art.

In Paragraph 4 on page 4 of the Office Action, claims 2, 6, 9 and 10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Iida in view of Fujikawa and further in view of Tamatsuka. Claim 9, which is the only independent claim of the four claims rejected, is described hereafter.

On page 5 of the Office Action, it is asserted with respect to claim 9 that such claim is a product claim reciting process limitations. It is stated that the patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production. Therefore, the product taught by the combination of Iida, Fujikawa and Tamatsuka is said to read on the claimed silicon wafer because the product limitations are said to be taught by the combination of the three references. Again, this is based on an apparent misunderstanding of the present invention. As previously noted, as long as it is unknown that a pulling rate possible to obtain the N-region shifts faster by doping with carbon, Iida cannot be combined with Fujikawa. Namely, the

combination of carbon doping and the N-region cannot be taught from such references. Therefore, claim 9 cannot be derived from the references only by the requirement as the product. The process limitation that the silicon single crystal is pulled at a rate greater than the rate of pulling the silicon single crystal with no carbon doping is to further clarify the meaning of the silicon wafer of the present invention. Therefore, with or without this requirement, the patentability of claim 9 should be acknowledged.

Moreover, as amended herein, claim 9 includes the limitation "oxygen precipitation nuclei of 1 x 10^9 number/cm^3 or more are generated by a heat treatment at 600-1000°C thereto". As previously described, the combination of carbon doping, N-region, and density of oxygen precipitation nuclei cannot be derived from the combination of the cited references. Moreover, because claim 10 depends from claim 9, such claim is also submitted to clearly distinguish patentably over the art.

In Paragraph 5 on page 5 of the Office Action, claims 3 and 7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Iida in view of Fujikawa and further in view of Hourai et al. Likewise, in Paragraph 6 on page 6 of the Office Action, claims 4 and 8 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Iida in view of Fujikawa and Tamatsuka, and further in view of Hourai et al. Thus, claims 3, 7, 4 and 8 are said to be unpatentable, citing such three references together with Hourai. However, because such claims depend, directly or indirectly from claim 1 which is patentable over the art for the reasons discussed above, claims 3, 7, 4 and 8 should also be allowable.

In Paragraph 7 on page 7 of the Office Action, claims 1, 3, 5, 7 and 9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Hourai in view of Fujikawa. In this connection, it is stated in the Office Action that Hourai discloses

a method of forming silicon wafers with N-region, formed with careful control of the pulling rate and temperature gradient. Hourai does not disclose that the single silicon crystal is pulled while doping with carbon, but Fujikawa teaches growing a silicon single crystal while controlling the carbon concentration and the oxygen concentration. Therefore, according to the Office Action, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Hourai with Fujikawa to promote precipitation of oxygen, thereby producing an epi-wafer without an expensive EG treatment. Applicants' previous arguments are asserted with Iida being substituted for Hourai with respect to the disclosure of the N-region. Hourai only discloses a method of forming a silicon wafer with the N-region through the entire wafer. There would be no motivation to combine Fujikawa et al. with the above method, and it is impossible to pull a silicon single crystal at a high pulling rate.

In Paragraph 8 on page 8 of the Office Action, claims 2, 4, 6, 8 and 10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Hourai in view of Fujikawa and further in view of Tamatsuka. However, such claims depend, directly or indirectly, from claim 1 or claim 9 and contain all of the limitations thereof. Therefore, such claims are also submitted to clearly distinguish patentably over the cited art.

In Paragraph 9 on page 9 of the Office Action, claims 1-10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Asayama et al. in view of Iida or Hourai. However, adopting Applicants' reasons set forth above but with the substitution of Fujikawa for Asayama, the claims are submitted to clearly distinguish patentably over the attempted combination of references. More specifically, Asayama describes an epitaxial wafer doped with nitrogen and carbon, but does not describe or suggest growing the N-region crystal. It is unknown in

Asayama that a pulling rate possible to obtain the N-region shifts faster by doping with carbon. Therefore, as the reference does not disclose or suggest doping the N-region crystal with carbon, nor do the other references, it is impossible to obtain the working-effect of the present invention by selecting and attempting to combine such references.

In Paragraph 11 on page 12 of the Office Action, it is stated that Applicants' arguments filed on October 14, 2003 have been fully considered but are not persuasive. It is stated that the features upon which Applicant relies (i.e., compensation of the weak point of doping nitrogen by doping with carbon to obtain a synergistic effect) are not recited in the rejected claims. However, such phrase cannot be inserted into claims 1 and 9 in their present form inasmuch as they describe only carbon doping. However, such claims are submitted to clearly distinguish patentably over the art in their present form. Moreover, in the last paragraph on page 12 of the Office Action, the Examiner asserts that "the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious". However, as previously discussed in connection with claims 1 and 9, combining the carbon doping and the N-region is not obvious, and there is no suggestion or motivation therefore in the cited references. It would not have been obvious to a person of ordinary skill in the art at the time of the invention that the N-region crystal can be pulled faster by doping with carbon, as long as the fact that the V/G value possible to obtain the N-region shifts by carbon doping is not clarified, it is impossible for one of ordinary skill in the art to control the pulling rate as in the case of claims 1 and 9. The cited references control the V/G only to a conventional value. In accordance with the present invention, for the first time it is discovered that the V/G value possible to

obtain the N-region shifts by carbon doping. Thereby, it was accomplished in accordance with the present invention for the first time that the single crystal having the N-region can be pulled faster.

By way of summary, many of the assertions set forth in the Office Action appear to be nothing more than with the benefit of hindsight based on the present invention. There is no suggestion in the art that the N-region crystal is doped with carbon. The cited references are combined only in accordance with the teaching described by the present invention that the N-region crystal is doped with carbon. The Office Action attempts to show that each constituent feature of the present invention is known in the art by citing references for each such feature. Because the present invention is the result of a combination of such features, it becomes necessary to attempt to prove the existence or suggestion or motivation for combining the cited references so as to arrive at the advantages of the combination. However, the Office Action attempts to combine the cited references without suggestion or motivation for deriving the present invention, and by asserting that the working effect, described only by the present invention, is naturally derived from the combination of references. Consequently, claims 1-10 define inventions which are submitted to clearly distinguish patentably over the attempted combinations of art.

In conclusion, claims 1-10 are submitted to clearly distinguish patentably over the prior art for the reasons discussed above. Therefore, reconsideration and allowance are respectfully requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (213) 337-6846 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

HOGAN & HARTSON L.L.P.

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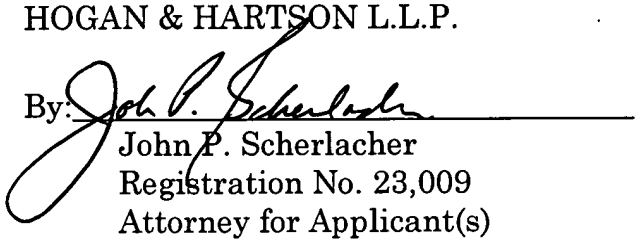
By: 

John P. Scherlacher
Registration No. 23,009
Attorney for Applicant(s)

500 South Grand Avenue, Suite 1900
Los Angeles, California 90071
Phone: 213-337-6700
Fax: 213-337-6701